

**Project** MetroWest Phase 1 Modelling & Appraisal      **Date** 23<sup>rd</sup> July 2014  
**Subject** MetroWest Phase 1 Wider Impacts Assessment      **Ref** 467470.AU.02.00  
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## 1 Purpose of This Document

This document outlines key steps and assumptions in estimating wider impacts of MetroWest Phase 1 and initial findings. The methodology adopted is in line with guidance in WebTAG Unit A2.1 and the process set out in technical note 'Proposal for Assessing Wider Impacts of MetroWest', which was prepared by CH2MHILL on 23<sup>rd</sup> May 2014 in its capacity to provide modelling and appraisal advice for developing Phase 1 of MetroWest.

The remainder of this document is structured as follows:

- Section 2: Basic Assessment Specification;
- Section 3: Agglomeration;
- Section 4: Imperfect Competition;
- Section 5: Tax Revenues from Labour Supply Effects; and
- Section 6: Summary.

## 2 Basic Assessment Specification

### Type of Impacts Assessed

This assessment investigates three types of wider impacts as a result of MetroWest Phase 1 as set out below:

- Agglomeration – By reducing journey times across the West of England region, the relative agglomeration<sup>1</sup> of business in this area will increase. This will have a direct impact on the productivity and GDP of the UK and is a central element to the estimation of Wider Impacts;
- Output change in imperfectly competitive markets – A reduction in the costs of transport allows businesses to operate more efficiently, improves their output and intensity of business practices, and hence allows for benefits; and
- Labour supply impacts – This captures tax revenues arising from the welfare effects to the UK economy of having a wider human resource pool. As travel costs are reduced, more workers will be attracted to the workplace from either new areas accessible by the scheme or areas that are already connected receiving an improved service.

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<sup>1</sup> Agglomeration is a term used to infer the ability of an economy to act through the density of companies to interact with one another.

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### Appraisal Period

This assessment captures the aforementioned wider impacts accrued over a 60-year appraisal period from the scheme opening year 2019 to 2078. Two Do-Something scenarios, Enhanced and Baseline timetables, were assessed against the same Do-Minimum. The correspondence between the two scenarios assessed here and full scenarios proposed for MetroWest Phase 1 is presented in Table 3.1, with detailed definition of the latter documented in the Preliminary Business Case (PBC) report.

*Table 2.1*

**Correspondence between Scenarios in Wider Impacts Assessment and Preliminary Business Case**

Wider Impacts Assessment	All Scenarios Proposed as Documented in Preliminary Business Case (PBC)
Baseline timetable	Scenario 1 – Option 5b with 6 units; Scenario 2 – Option 5b with 7 units
	Scenario 3 – Option 6b with 6 units; Scenario 4 – Option 6b with 7 units
Enhanced timetable	Scenario 5 – Option 5b enhanced with 6 units; Scenario 6 – Option 5b enhanced with 7 units
	Scenario 7 – Option 6b enhanced with 6 units; Scenario 8 – Option 6b enhanced with 7 units

### Geographical Detail

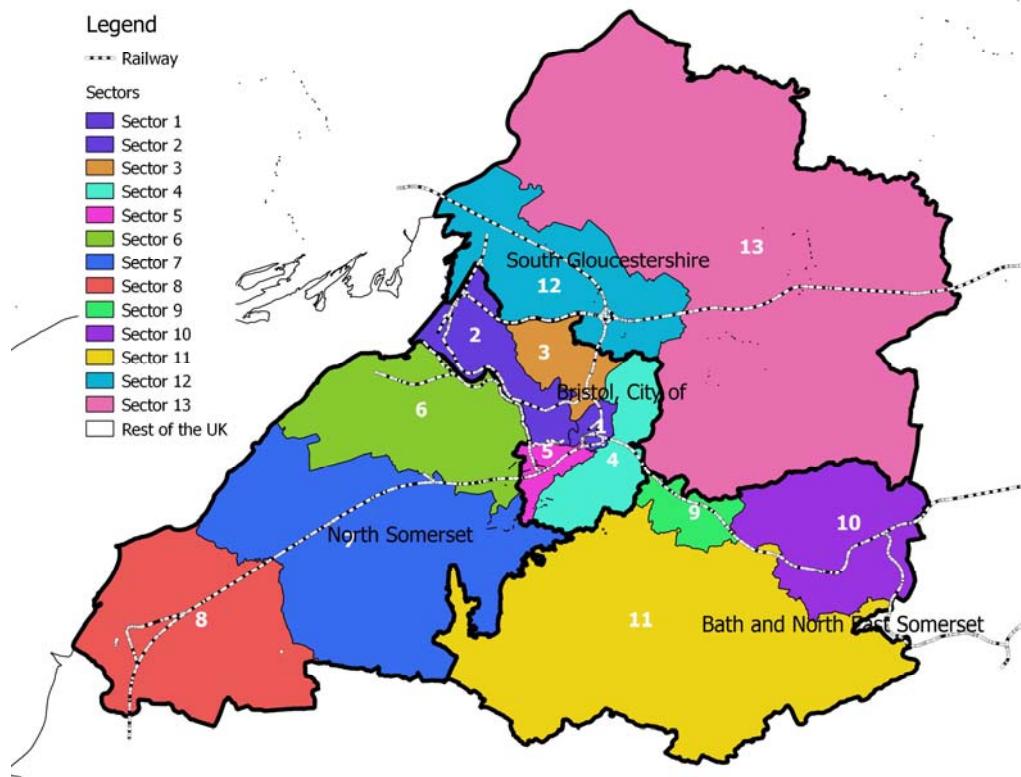
The main input for Wider Impacts Assessment includes DfT's standard economic dataset and outputs from GBATS<sup>2</sup> models supplemented by other information such as local planning data and demographic information for the study area under investigation. As these data comes with varying geographical detail, a sector system was adopted to reconcile such discrepancy and also provide sufficient detail to enable decision-makers to understand the geographical distribution of wider impacts in West of England and areas further afield. The sector system was defined taking on board the following three aspects:

- Extent of coverage – consideration was given to the extent to which that MetroWest Phase 1 network goes as well as the area for which that GBATS3 modelling suite is capable of producing reasonably detailed output. The extent of coverage was also selected based on individual Local Authority District (LAD) boundary in order to be consistent with the format of the DfT's economic dataset. Four LAD's were included in the area of investigation, namely Bath and North East Somerset, Bristol City, North Somerset and South Gloucestershire;
- Sectoring – each selected LAD was split into sectors for examination of benefit distribution across different parts of the region. Compatibility with different tiers of geographical area definition was the key for defining the sector system in order to facilitate access to other data that is readily available. The formulated sectors are therefore aggregation of traffic zones in GABTS3 and also follow Ward boundaries (or its aggregation) so modelling output and existing demographic information can be taken on board with ease; and
- Fitness for purpose – formulation of sectors also considered significant elements of the proposed MetroWest scheme, e.g. new stations, so the methodology framework is capable for providing insight on how different elements of interventions are likely to contribute to the overall wider impacts, should relevant input data can be made available.

Following the principles set out above, the proposed sectoring system is illustrated in Figure 2.1. The four LADs in West of England are split into 13 different sectors, with the rest of the UK represented by sector no.14.

<sup>2</sup> GBATS is a multi-modal transport model covering West of England. Detail of the model specification, functionality and its validation are available in the PBC and supplementary documents.

**Figure 2.1**  
**An Illustration of the Adopted Sector System**



### 3 Agglomeration

The calculation of agglomeration impacts follows the method set out in Appendix D of WebTAG Unit A2.1, based on demographic data as well as generalised travel demand and costs for business and commuting trips.

Table 3.1 summarises data used for estimating the agglomeration impact including their sources and key assumptions adopted. Further information is set out in subsequent tables.

**Table 3.1**  
**Data Used for Agglomeration Impact Calculation**

Data required	Source & Assumptions
Local GDP per Worker	DfT Sectoral GDP forecasts for individual LAD's were used. Values for 2019 were interpolated based on DfT forecasts for 2016 and 2021. No variation in GDP per worker within individual LAD's was considered.
Sectoral and total employment forecasts	DfT Sectoral and total employment forecasts for individual LAD's were used. Values for 2019 were interpolated based on DfT forecasts for 2016 and 2021. Total employment figures were apportioned to each geographical sector of individual LAD's based on information derived from GBATS3 model and presented in Table 3.2 and Table 3.3.
Agglomeration elasticities by industrial sector	Recommended values from Table 1 at Page 9 of TAG Unit A2.1 were adopted.
Parameter for distance decaying	Recommended values from Table 1 at Page 9 of TAG Unit A2.1 were adopted.

Data required	Source & Assumptions
Public Transport generalised cost matrices weighted across user groups	Journey time skims for Do Minimum scenario were taken from GBATS3 output and used to derive generalised costs based on standard Value of Time (VOT) from DfT's latest TAG Data Book. Journey time saving as a result of MetroWest Phase 1 was derived based on sector-to-sector movements and deducted from the Do Minimum values to derive Do Something travel time. This again was converted generalised travel cost based on TAG compliant VOT. This approach ensures that all benefits derived are directly attributed to the proposed scheme and removes the risk of introducing spurious benefits as a result of potential 'modelling noise'.
Highway generalised cost matrices weighted across user groups	Journey time, distance and road charge skim matrices were taken from GBATS3 output and converted the generalised travel cost following standard approach and parameters for VOT and VOC calculation in the latest TAG Data Book. In order to remove 'modelling noise' in the current GBATS3 model suite, the highway travel cost for Do Something scenario was assumed to be the same as its counterpart in Do Minimum due to the fact that modal shift from road users to rail is very minor. This is a conservative approach as the minor modal shift would generate decongestion benefits and hence reduce travel cost in reality despite the absolute change is small.
Public Transport trip matrices	Travel demand matrices, including all sub-modes (bus, BRT and rail) were taken from GBATS3 output. Business and commuting journeys were extracted separately.
Hwy trip matrices by journey purpose and time period	Travel demand matrices were taken from GBATS3 output. Business and commuting journeys were extracted separately. Highway car trips were converted to person trips using appropriate occupancy values from the latest TAG Data Book.

Information in Table 3.2 is the number of employment in each LAD by employment sector, which is in line with assumptions in TAG Data Book for year 2031. Table 3.3 illustrates how information in Table 3.2 was apportioned to individual geographical sectors based on ratios derived from the number of arriving commuting trips in each sector during the AM peak. The volume of arriving commuting trips in the AM was regarded as a proxy (in relative terms) for number of jobs in this process.

**Table 3.2**  
**2031 Employment by LAD**

Local Authorities	Manufacturing	Construction	Consumer Services	Producer Services	Total
Bath and North East Somerset	5123	3943	24098	19794	52958
Bristol City	11776	9012	48154	97666	166608
North Somerset	6578	3885	28408	21479	60350
South Gloucestershire	14189	11288	47903	46104	119484

**Table 3.3**  
**2031 Employment by Sector**

Local Authorities	Sector	Ratio	Manufacturing	Construction	Consumer Services	Producer Services	Total
Bristol City	1	13%	1584	1212	6477	13137	22410
Bristol City	2	38%	4468	3420	18272	37060	63220
Bristol City	3	17%	2019	1545	8255	16742	28560
Bristol City	4	25%	2895	2215	11837	24008	40956
Bristol City	5	7%	810	620	3313	6719	11461

Local Authorities	Sector	Ratio	Manufacturing	Construction	Consumer Services	Producer Services	Total
North Somerset	6	45%	2941	1737	12699	9602	26978
North Somerset	7	29%	1911	1129	8253	6240	17534
North Somerset	8	26%	1726	1020	7455	5637	15838
Bath and North East Somerset	9	22%	1124	865	5287	4342	11618
Bath and North East Somerset	10	52%	2659	2046	12506	10272	27482
Bath and North East Somerset	11	26%	1341	1032	6306	5180	13858
South Gloucestershire	12	54%	7665	6098	25879	24907	64549
South Gloucestershire	13	46%	6524	5190	22024	21197	54935

Agglomeration impacts were estimated for year 2019 and 2031 and then profiled<sup>3</sup> across the appraisal period between 2019 and 2078, and discounted to 2010 prices and values. Results from this analysis are presented in Table 3.4.

*Table 3.4*

**Agglomeration Impacts**

Agglomeration Impacts (£000's)	Baseline Scenario	Enhanced Scenario
2019	£1,236	£1,240
2031	£2,051	£2,057
2019 to 2078 (discounted)	£49,099	£49,243

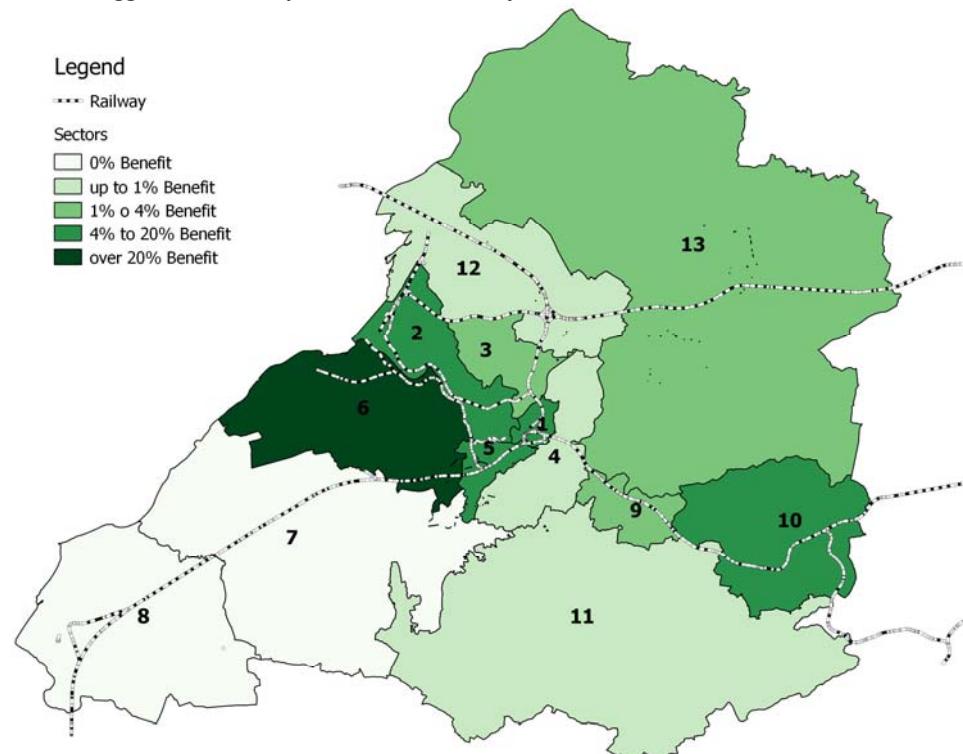
Figure 3.1 illustrates how the estimated agglomeration impacts distribute across different geographic sectors in both options assessed using different shades of green. Darker colour in this figure represents higher percentage of agglomeration impact.

The distribution pattern in Figure 3.1 was 'sense checked' by comparing against information in Table 3.5. Table 3.5 summarises movements in West of England that are anticipated to benefit from different lines of the proposed scheme either through improved journey time or enhanced frequency of rail service.

It can be seen that there is strong correlation in the distribution pattern of agglomeration benefits and where impacts from rail improvement are expected between Figure 3.1 and Table 3.5. The sectors with higher agglomeration impacts are generally aligned with origins from which travel time benefits are expected from one or more rail services where improvements are proposed as part of MetroWest Phase 1. Sector 6 enjoys the highest benefits as a result of the new station and frequency enhancement brought by improvements to Portishead line. Clear benefits to other sectors in Bristol, South Gloucester and Bath and Northeast Somerset are also observed, which can be attributed to impacts from Severn Beach line and Bristol City to Bath line.

<sup>3</sup> Agglomeration impacts were assumed to change over time at the same rate as user VOT.

**Figure 3.1**  
**Distribution of Agglomeration Impacts across the Study Area**



**Table 3.5**  
**An Illustration of Where Impacts from MetroWest Phase 1 are Expected**

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1		C	C		A	A			B	B		C	
2	C	C	C	C	C	A&C			B	B	C	C	C
3	C	C		C	C	A&C			B	B	C	C	
4		C	C			A			B	B		C	
5	A	C	C			A			B	B		C	
6	A	A&C	A&C	A	A				A&B	A&B	A	A	A
7													
8													
9	B	B	B	B	B	A&B			B		B	B	
10	B	B	B	B	B	A&B			B		B	B	
11	C	C				A						C	
12	C	C	C	C	C	A			B	B	C		
13	C					A			B	B			

\* Line A – Portishead Line (new station and frequency improvement)

\* Line B – Bristol City to Bath Line (frequency improvement)

\* Line C – Severn Beach Line (frequency improvement)

## 4 Imperfect Competition

TAG Unit A2.1 suggests that the imperfect competition impact can be calculated as 10% of business user benefits which will have already been interpolated, extrapolated and discounted over the appraisal period. No further profiling or discounting is required.

Table 4.1 presents the estimated imperfect competition impact, which is 10% of the business user benefits in rail and highway. Overall the total value of benefits is approximately £2m. As the rail user economic appraisal was undertaken at a finer level of detail to differentiate subtle difference between scheme options, this adds an extra dimension in the result (all scenarios split by options 5B and 6B). Detailed definition of these proposed options is available in the PBC report.

*Table 4.1*

**Imperfect Competition Impacts**

(£000's)	Baseline Scenario		Enhanced Scenario	
	Option 5B	Option 6B	Option 5B	Option 6B
Imperfect Competition Impacts	£1,973	£1,708	£2,014	£1,760

## 5 Tax Revenues from Labour Supply Effects

The calculation of labour supply impact also follows the method set out in Appendix D of TAG Unit A2.1, based on inputs similar to what was used for estimating agglomeration impact, as listed in Table 5.1.

*Table 5.1*

**Labour Supply Impacts Data**

Data required	Source / Challenges & Solutions
Elasticity of labour supply with respect to net return from working	DfT economic dataset; Recommended value is 0.1, Table 2 at Page 9 of TAG Unit A2.1
Number of workers living in zone $i$ and working in zone $j$ varying by forecast year	2011 Census data ('KS601EW to KS603EW - Economic activity by sex') was used to derive the total number of workers by LAD (economically active population in employment). The distribution of number of workers (by residence) to the sectors where their workplaces are is based on information derived from the GBATS3 AM commuting trip matrices. The total number of HBW trips in the AM was used as the weighting to apportion total number of workers from one sector to sub-groups by their respective destination sectors.
Mean gross workplace-based earnings by zone	DfT economic dataset
Median wage of marginal worker entering the labour market by zone	Derived from DfT economic dataset
Average tax rate	DfT economic dataset; Recommended value is 0.3, Table 2 at Page 9 of TAG Unit A2.1
Pay of marginal worker compared to average worker	DfT economic dataset; Recommended value is 0.69, Table 2 at Page 9 of TAG Unit A2.1
Round-trip commuting generalised cost	Derived from relevant generalised cost data listed in Table 3.1.
Tax take on increased labour supply parameter	This is equal to 40% in accordance with guidance in WebTAG

Detailed information on the number of workers (by residence) was required for estimating increased tax revenues from Labour Supply Effects. This was derived using a combination of 2011 Census data and information from TEMPRO and presented in Table 5.2. Information in Table 5.2 was disaggregated to individual geographic sectors using the number of home-based work trips from GBATS3 model output for the AM peak hour.

*Table 5.2***Numbers of Workers in Each LAD by Residence**

Numbers of Worker	2011	2019	2031
Bath and North East Somerset	79,491	83,778	86,477
Bristol	197,915	214,391	232,160
North Somerset	94,139	97,432	103,080
South Gloucestershire	131,089	139,431	145,507

\* 2011 values were taken from 2011 Census data ('KS601EW to KS603EW - Economic activity by sex')

\* 2019 and 2031 values were derived based on growth factor for workers derived from TEMPRO dataset 6.2

Values of the estimated increase in tax revenues from Labour Supply Effects for the modelled forecasting years and the entire appraisal period are presented in Table 5.3.

*Table 5.3***Increase in Tax Revenues from Labour Supply Effects**

Agglomeration Impacts (£000's)	Baseline Scenario	Enhanced Scenario
2019	£65	£66
2031	£55	£55
2019 to 2078 (discounted)	£1,451	£1,456

## 6 Summary

This note outlines the methodology for estimating three types of wider impacts arising from the proposed MetroWest Phase 1 scheme. It sets out the overall assessment specification, the proposed geographical detail, data used, key assumptions adopted and initial findings for each of the three impacts.

Over the 60-year appraisal period between 2019 and 2078, assessment results indicate that the agglomeration impact is about £49m with very minor difference between all options considered. Distribution of this impacts across the study area was cross-checked against components of rail improvements in MetroWest Phase 1 and where their impacts are anticipated.

The impact due to output change in imperfectly competitive markets is usually 10% of the business user benefits and is estimated to be approximately £2m across all options. Increase in tax revenues from labour supply effects as a result of the proposed MetroWest Phase 1 scheme is under £2m.

In light of the above findings, the total value of wider impacts for the PBC WEB assessment is in the order of £52m.